gard, velocity-encoded MR can measure diastolic retrograde flow in the ascending aorta. The technique has provided an accurate direct measurement of the volume of aortic regurgitation in patients with this disease.[8] Moreover, sequential studies in a group of patients with isolated aortic regurgitation have shown excellent interstudy reproducibility of the measurement.[8] This finding indicates that velocity-encoded MR could be used as a reproducible method for monitoring the volume of regurgitation over time and documenting the effectiveness of pharmacologic interventions intended to reduce the severity of regurgitation. Preliminary results of the use of this technique to assess the effectiveness of an angiotensin-converting enzyme inhibitor in several patients with aortic regurgitation demonstrate effectiveness of the drug in some but not all patients.[9] Although imaging studies are not currently applied for this purpose, a technique for precisely quantifying the hemodynamic effect of a drug might be used in the future to define the therapeutic regimen in patients with valvular regurgitation.

In another recent paper, the feasibility of using velocity-encoded MR for measuring blood flow in coronary arteries was indicated.[10] In normal coronary arteries, administering a vasodilator caused a substantial increase in the velocity of blood flow. On the other hand, velocity-encoded MR showed no increase in flow velocity in response to the vasodilator in coronary arteries with severe stenoses. Velocity-encoded MR is the only method for measuring blood flow in native coronary arteries; consequently, a unique use would be to identify arteries with hemodynamically important stenoses.

A unique application in congenital heart disease is suggested by another recent observation. The use of velocity-encoded MR to measure flow in the proximal and distal descending thoracic aorta in normal subjects indicated a small decrease in flow volume from proximal to distal aorta consistent with normal runoff into the intercostal arteries.[11] In patients with moderate to severe coarctation of the aorta, however, flow increased substantially from the proximal to the distal aorta, due presumably to retrograde flow in the intercostal and other arteries recruited into supplying blood to the lower body. Thus, a unique application of velocity-encoded MR is to quantify collateral flow in patients with coarctation of the aorta to predict the neurologic risk of cross clamping the aorta at the time of surgical repair.

In addition, velocity-encoded MR provides a method for assessing the cross-sectional and longitudinal flow pattern in the aorta. It will be intriguing to determine if flow patterns vary with age and between normal subjects and those with atherosclerosis. These techniques also provide a window on the vascular aging process by permitting repeated noninvasive assessment of arterial compliance.[12] Magnetic resonance techniques will undoubtedly be used to investigate the variation in aortic compliance associated with the aging process and in response to exercise regimens and pharmacologic interventions.

Whereas imaging techniques have been focused on the examination of abnormal anatomy, it is clear that the strength of this new technology for use in the cardiovascular system should be developed and appropriately applied to quantify abnormal cardiovascular function. Its eventual role will likely depend on establishing the clinical importance of the unique information it can supply.

CHARLES B. HIGGINS, MD
Chief, MRI Section
Department of Radiology
University of California,
San Francisco, School
of Medicine

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Needle Biopsy of Probably Benign Nonpalpable Breast Lesions

THE BOTTOM LINE of screening mammography is that it can reduce mortality from breast cancer by about 30%. This is accomplished at a cost of about $30,000 per year of life expectancy gained—$15,000 to $125,000, depending on factors such as statistical methods, age of the women, the addition of breast physical examinations, and the decision to do biopsies of probably benign lesions.[1-3]

In women undergoing routine screening mammography—soon to be most women in this country—about 50% of all biopsies are done for nonpalpable or occult lesions (whereas 20% to 40% of all breast cancers will be nonpalpable). These occult masses or microcalcifications are the subject of considerable controversy. Mammographers argue about when to take a biopsy of the commonly identified slightly suspicious, or probably benign, lesions. When biopsies are taken of these nonpalpable lesions, there is difference of opinion about whether this should be done surgically after mammographic localization, or stereotaxically using fine-needle aspiration or large-core-needle techniques.

How frequently a biopsy is recommended and performed on probably benign nonpalpable breast lesions depends almost entirely on the skill and philosophy of the radiologist interpreting the mammogram and the medical malpractice environment in which he or she works.[3] Positive predictive values (PPVs) for carcinoma on biopsies of such occult lesions in large series in the United States are generally 20% to 30%, with a range from 15% to 40%.[3,4] Corresponding PPVs in European series are considerably higher, ranging as high as 70%.[4] These values generally increase ("improve") as mammographers become more experienced and the published series become larger.[3-7] Between 20% and 40% of nonpalpable carcinomas are ductal carcinomas in situ, and the pathologic diagnosis and surgical treatment of this disease are the subject of further controversy.

Elsewhere in this issue, Shields and co-workers give their experience in the biopsy of mammographically detected nonpalpable lesions.[8] These authors had an overall PPV of carcinoma of 19% and a PPV of only 7% in women younger than 50. These low figures, and the relatively small number of biopsies (125), suggest that this was an early experience with suboptimal mammographic skill. Unfortunately, there is no ideal PPV for such lesions, and a tradeoff exists between costs and benefits.[1,4] It is important to realize that an overall PPV of 20% does not mean that an individual patient has a 1 in 5 chance of having carcinoma. Many nonpalpable lesions are highly suggestive of malignancy, and an overall figure of 20% indicates that biopsies are being done of individual lesions that are much less suggestive of cancer than 1 in 5. Those few carcinomas that are observed rather than undergoing immediate biopsy are not "missed." Rather, the 6- to 12-month delay in diagnosis should be viewed in the context of the normal 8- to 10-year life span of breast carcinoma before it becomes palpable. Finally, many nonpalpable calcifications are ductal carcinomas in situ, and, as in the case of in situ prostate carcinoma, many of these lesions will probably never progress to an invasive life-threatening cancer.[1]

What does all this mean? Is needle-directed biopsy overused? First, I heartily agree with the conclusions of Shields and associates that too many biopsies in their series were done for probably benign lesions seen at mammography in women younger than 50.[8] I also think that too many biopsies were done in their entire series (PPV 19%) and in many other published series.

Shields and colleagues also suggest that women younger than 50 who have nonpalpable breast lesions on their mammograms should have those examinations reviewed by an experienced mammographer before biopsy. Again, I fully agree with this recommendation, but it does not go far enough. Any woman who has a nonpalpable breast lesion recommended for biopsy should have that recommendation made, or confirmed, by an experienced mammographer.[3,7] Such consultations rarely require a formal written report and can be accomplished in a few minutes if the referring physician is in attendance. Our radiology department does about two such consultations per day at no charge. In my opinion, no surgeon or institution should perform biopsies of nonpalpable lesions without the available skills of dedicated mammographers.

FERRIS M. HALL, MD
Department of Radiology
Beth Israel Hospital
Harvard Medical School
Boston, Massachusetts

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